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**TITLE****METHOD AND SYSTEM OF IMPLEMENTING REAL-TIME VIDEO-  
AUDIO INTERACTION BY DATA SYNCHRONIZATION****BACKGROUND OF THE INVENTION****5 Field of the Invention**

The present invention relates to a real-time video-audio interaction technology and in particular to a method of implementing real-time video-audio interaction by data synchronization in an Internet  
10 game.

**Description of the Related Art**

Generally speaking, the system architecture of an Internet game comprises an Internet game server and Internet game clients. The Internet game server  
15 receives and processes data from the Internet game clients to execute the Internet game. The Internet game clients interact with other Internet game clients and the Internet game. In other words, all the data required by the Internet game is sent to the Internet  
20 game server for data processing and data operation. Real-time video-audio interaction utilizes a camera and microphones in an Internet game client to retrieve the real-time data and transmit the retrieved data through the Internet to other Internet game clients  
25 for interaction.

Client's ref.: 92022

File: 0660-9881-US/Final/Teresa/Steve

Three main technological difficulties limit Internet game systems' support of real-time video-audio interaction. First, current video display technology in an Internet game cannot display a real-time video picture if 3D animation occupies the display. Second, if the compression and transmission of video and audio data are executed solely in the Internet game server, the server becomes overloaded and bandwidth is compromised, affecting the speed of the Internet game. Third, the degree of video and audio data synchronization affects the result in real-time interaction. Hence, presently, real-time video-audio interaction is not supported in an Internet game.

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#### SUMMARY OF THE INVENTION

Accordingly, an object of the invention is to provide a method of establishing an Internet transmission channel between Internet game clients, compressing and packaging real-time video-audio data in the Internet game clients, and transmitting the packaged data to other Internet game clients. The Internet game client that receives the transmission package, i.e. the recipient Internet game client, decodes the transmission package and applies a module simultaneously supporting real-time video and 3D animation to display the real-time video data when 3D animation occupies the display in an Internet game. In addition, the recipient Internet game client utilizes a sound card, cooperating with audio input or

Client's ref.: 92022

File: 0660-9881-US/Final/Teresa/Steve

output, to output the real-time audio data back. The module simultaneously supporting real-time video and 3D animation outputs the real-time video data by integrating the real-time video data into game environments of the Internet game as texture mapping, accomplishing simultaneous display.

To achieve the foregoing and other objects, the invention overcomes conventional real-time data interaction problems in an Internet game. In one embodiment, the inventive method first establishes an Internet transmission channel between sender and recipient Internet game clients, without first connecting to an Internet game server. Next, the Internet game clients execute the Internet game and connect to the Internet game server.

Then, real-time video and audio data are retrieved by the sender Internet game client, which then compresses/encodes the retrieved real-time video data into video data frames, compresses/encodes the real-time audio data into audio data packets, packaging both into a transmission package. The transmission package is then transmitted to the recipient Internet game client through the Internet transmission channel. A time stamp is attached in the transmission package for synchronizing the video and audio data.

Finally, the recipient Internet game client decodes the transmission package into real-time video and audio data. The recipient Internet game client synchronizes the real-time video and audio data

Client's ref.: 92022

File: 0660-9881-US/Final/Teresa/Steve

according to the time stamp, outputs the decoded real-time video data in game environments, and outputs the decoded real-time audio data, achieving real-time video-audio interaction in the Internet game.

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#### BRIEF DESCRIPTION OF THE DRAWINGS

The present invention can be more fully understood by reading the subsequent detailed description and examples with references made to the accompanying drawings, wherein:

10        Fig. 1 is a flowchart of the method of implementing real-time video-audio interaction by data synchronization in an Internet game.

15        Fig. 2 is a diagram of the system of implementing real-time video-audio interaction by data synchronization in an Internet game.

Fig. 3 is a detailed diagram of the system of implementing real-time video-audio interaction by data synchronization in an Internet game.

20        Fig. 4a, Fig. 4b are diagrams of the method of implementing real-time video-audio interaction by data synchronization in an Internet game.

#### DETAILED DESCRIPTION OF THE INVENTION

25        As summarized above, the present invention provides a system and method overcoming conventional real-time data interaction problems in an Internet game, first establishing an Internet transmission channel between Internet game clients without first connecting to an Internet game server. Next the

Client's ref.: 92022

File: 0660-9881-US/Final/Teresa/Steve

Internet game clients execute the Internet game and connect to the Internet game server.

The Internet transmission channel is established as follows. First, the sender Internet game client  
5 assigns an Internet address of a recipient Internet game client directly or according to a directory which may include all the Internet addresses of possible recipient Internet game clients. The sender Internet game client then transmits a connection request to the  
10 recipient Internet game client. The recipient Internet game client establishes the Internet transmission channel in response to the connection request.

Real-time video and audio data are retrieved in  
15 the sender Internet game client, which then compresses/encodes the retrieved real-time video data into video data frames, the real-time audio data into audio data packets, packaging both into a transmission package. The transmission package is then transmitted  
20 to the recipient Internet game client through the Internet transmission channel.

If the bandwidth of the Internet transmission channel is not sufficient to transmit the real-time video and audio data, the real-time audio data takes  
25 priority over real-time video data. The advantage of considering audio data first is that audio data can be highly compressed. Thus, even if the bandwidth of the internet transmission channel is seriously deficient, the smooth of real-time audio data can be maintained,

Client's ref.: 92022

File: 0660-9881-US/Final/Teresa/Steve

achieving the basic requirement of real-time interaction.

Finally, the recipient Internet game client decodes the transmission package into real-time video  
5 and audio data. The recipient Internet game client synchronizes the real-time video and audio data according to the time stamp, outputs the decoded real-time video and audio data in game environments.

One important concern of video-audio data  
10 synchronization is maintaining correct time information for data display. If an Internet game client retrieves and displays real-time video-audio data, data synchronization is not a problem because the display time is synchronized to the system time of  
15 the Internet game client. If the Internet game client that retrieves real-time data is different from the display client, then the display client has to add the system time and the time stamp together as the display time.

20 Conversely, because the transmission package considers the audio data first, there may be fewer transmitted video data frames than originally retrieved video data frames. The decompression of the transmission package may also drop some video data  
25 frames because of the data compression reference (IPB). Thus, the mentioned time stamp and the amount of real-time video data must be applied to drop video data frames to achieve the expected result of video-audio data synchronization. The data synchronization

Client's ref.: 92022

File: 0660-9881-US/Final/Teresa/Steve

can be processed before or after the video-audio data decompressing/decoding.

Further, the invention provides a system of implementing real-time video-audio interaction by data  
5      synchronization in an Internet game. The inventive system includes an Internet game server and Internet game clients. The Internet game server executes an Internet game main program. The Internet game clients comprise interactive Internet game clients and an  
10     Internet transmission channel. The Internet game clients connect to the Internet game server, and the Internet transmission channel connects to the interactive Internet game clients, i.e. the sender and recipient Internet game clients.

15     The sender Internet game client has a real-time data retriever, data encoder, transmission packager, and Internet sender. The real-time data retriever retrieves real-time video and audio data from the Internet game client. The data encoder  
20     compresses/encodes the real-time video data into video data frames, and the real-time audio data into audio data packets. The transmission packager then packages the encoded video and audio data packets into a transmission package. A time stamp is attached to the  
25     transmission package. The time stamp enables synchronization between the real-time video and audio data. The Internet sender transmits the transmission package to the recipient Internet game client through the Internet transmission channel.

Client's ref.: 92022

File: 0660-9881-US/Final/Teresa/Steve

Here, the Internet transmission channel is established according to the steps mentioned above. Again, if the bandwidth of the Internet transmission channel cannot accommodate the real-time audio and video data simultaneously, the real-time audio data takes priority over the real-time video data.

The recipient Internet game client includes a data decoder and a video-audio playback system. The data decoder decodes the transmission package into real-time video and audio data. The video-audio playback system outputs the decoded video and audio data according the time stamp attached to the transmission package. Similarly, the video-audio playback system integrates the decoded real-time video data into game environments of the Internet game as texture mapping. The data is synchronized by adding the system time of the second internet game client and the time stamp together as the display time of the second real-time video and audio data. Data may also be synchronized comparing the time stamp to the amount of the second real-time video data and the number of frames dropped from the second real-time video data.

Moreover, the invention provides a method of real-time video-audio interaction by data synchronization in an Internet game for application in an Internet game client. The Internet game client first establishes an Internet transmission channel to an external Internet game client without connecting to the Internet game server. The Internet game client



Client's ref.: 92022

File: 0660-9881-US/Final/Teresa/Steve

then connects to the Internet game server and executes the Internet game.

Thereafter, real-time video and audio data are retrieved by a real-time data retriever and  
5 compressed/encoded into a transmission package. A time stamp is attached to the transmission package for data synchronization. The time stamp expresses the synchronous relationship between the real-time video and audio data. The transmission package is  
10 transmitted to the external Internet game client through the Internet transmission channel.

The Internet transmission channel is established by a specific procedure. The Internet game client assigns an Internet address to the external Internet  
15 game client directly or according to a directory which may include all the Internet addresses of possible external Internet game clients. The Internet game client then transmits a connection request to the external Internet game client. The external Internet  
20 game client establishes the Internet transmission channel in response to the connection request. If the bandwidth of the Internet transmission channel cannot support the real-time audio data and video data simultaneously, the real-time audio data takes  
25 priority over real-time video data.

The Internet game client receives a transmission package from the external Internet game client through the Internet transmission channel. The Internet game client decompresses/decodes the transmission package  
30 into real-time video and audio data. The Internet

Client's ref.: 92022

File: 0660-9881-US/Final/Teresa/Steve

game client then synchronizes the decoded video and audio data according to the time stamp attached to the transmission package, and outputs the decoded audio and video data in the Internet game.

5        One embodiment of the invention is directed to a storage medium for storing a computer program, wherein the computer program, when applied to a computer system, implements real-time video and audio interaction by data synchronization between Internet  
10 game clients. The method may include the steps mentioned above.

Another embodiment is directed to a computer system of an Internet game, executing an Internet game and having a storage medium for storing a computer  
15 program, wherein the computer program is applied to a computer system and implements real-time video-audio interaction by data synchronization between Internet game clients. The method may include the steps mentioned above.

20        Fig. 1 is a flowchart of the method of implementing real-time video-audio interaction by data synchronization in an Internet game. The method first establishes an Internet transmission channel between clients without connecting to an Internet game server  
25 (step S100). The Internet transmission channel can be established by any standard Internet transmission protocol, such as TCP/IP. The establishment of the Internet transmission channel is accomplished by certain steps. The sender Internet game client  
30 assigns an Internet address to a recipient Internet

Client's ref. : 92022

File : 0660-9881-US/Final/Teresa/Steve

game client directly or according to a directory which may include all Internet addresses of possible recipient Internet game clients. The sender Internet game client then transmits a connection request to the  
5 recipient Internet game client. The recipient Internet game client establishes the Internet transmission channel in response to the connection request.

Next, the internet game clients connect to the  
10 internet game server for executing the internet game (step S101). Real-time video and audio data are retrieved by the sender Internet game client (step S102). The real-time video data may be retrieved by a video capture device, such as a camera. The real-time  
15 audio data may be retrieved by an audio capture device, such as a microphone.

The sender Internet game client then compresses/encodes the real-time video data into video data frames, and compresses/encodes the real-time  
20 audio data into audio data packets (step S104). Compression can be accomplished by a standard data compression format, such as H.263, MPEG 1/2/4, or G723.

The video and audio data packets are then  
25 packaged into a transmission package (step S106). Smooth audio data transmission and the synchronization between video and audio data are the chief concerns of the Internet real-time video-audio data transmission, therefore, the inventive method gives the highest  
30 transmission priority to audio data in the

Client's ref. : 92022

File : 0660-9881-US/Final/Teresa/Steve

transmission package, such that, if the bandwidth of the Internet transmission channel cannot simultaneously support the real-time video and audio data transmission, the audio data takes priority over  
5 video data. A time stamp is attached to the transmission package for synchronizing the video and audio data (step S107). The time stamp attached to the transmission expresses the synchronous relationship between the real-time video and audio  
10 data, enabling synchronization between the real-time video and audio data. Thus, the inventive method guarantees smooth audio data transmission and accurate synchronization of video and audio data.

The transmission package is then transmitted to  
15 the recipient Internet game client through the Internet transmission channel (step S108). Finally, the recipient Internet game client decodes the transmission package into real-time video and audio data (step S110), synchronizes the real-time video and  
20 audio data according to the time stamp (step S111), outputs the decoded real-time video data to the Internet game environments, and outputs the decoded real-time audio data (step S112). The real-time interactive video data is integrated into the Internet  
25 game environments as texture mapping, to be simultaneously displayed in all the connected game environments as real-time video data.

The data synchronization in the step S111 may be based on the system time of the second internet game  
30 client, adding the time stamp, as display time of the

Client's ref.: 92022

File: 0660-9881-US/Final/Teresa/Steve

second real-time video and audio data. The data synchronization may base on the time stamp and refer to the amount of the second real-time video data to drop data frames of the second real-time video data.

5 Thus, fewer video frames will be displayed in a fixed time period, that is, the display time of each video data frame is prolonged to allow video and audio data synchronization.

The data synchronization of the step S111 can be  
10 processed before or after the step S110. If the data synchronization is processed before decoding, the video data frames may be dropped after decoding due to differences between decoders. If the data  
synchronization is processed after decoding, the  
15 dropped video frames are known, thus the number of dropped frames can be controlled.

Fig. 2 is a diagram of the system of real-time video-audio interaction by data synchronization in an Internet game of the invention. In one embodiment,  
20 the inventive system includes an Internet game server 20 and Internet game clients 24, 26, 28, 30. The Internet game server 20 executes an Internet game main program. The Internet game clients 24, 26, 28, 30, include interactive Internet game clients 24, 26, and  
25 an Internet transmission channel 32. The Internet game clients 24, 26, 28, 30, connect to the Internet game server 20 to establish an Internet game network 22. The Internet transmission channel 32 connects to the interactive Internet game clients 24 and 26  
30 without connecting to the Internet game server 20.

Client's ref. : 92022

File : 0660-9881-US/Final/Teresa/Steve

Fig. 3 is a detailed diagram of the system of real-time video-audio interaction by data synchronization in an Internet game. The sender Internet game client 300 has a real-time data retriever 302, a data encoder 304, a transmission packager 306, and an Internet sender 308. The real-time data retriever 302 retrieves real-time video and audio data from the Internet game client 300. The real-time data retriever 302 may comprise separate devices retrieving and processing video and audio data separately or an integrated device. The real-time data retriever 302 can be any data capture device, such as a camera or microphone.

The data encoder 304 compresses/encodes the real-time video data into video data frames, and the real-time audio data into audio data packets. The data encoder 304 may comprise separate devices to compress/encode video and audio data separately or an integrated device.

The transmission packager 306 assigns the audio frames highest transmission priority and packages the video frames and audio data packets into a transmission package. A time stamp is attached to the transmission package. The time stamp expresses the synchronous relationship between the video and audio data, that is, the time information of producing video and audio. The Internet sender 308 transmits the transmission package to the recipient Internet game client 320 through the Internet transmission channel 310. As an example, the transmission packager 306,

Client's ref.: 92022

File: 0660-9881-US/Final/Teresa/Steve

the Internet sender 308, and the Internet transmission channel 310 can be implemented by programming into computer-executive modules in program languages to achieve the operations described.

5       The recipient Internet game client 320 includes a data decoder 322 and a video-audio playback system 324. The data decoder 322 decodes the transmission package into real-time video and audio data. Here, the data decoder 322 can comprise separate devices or  
10   be an integrated device. The data encoder 304 and the data decoder 322 may be implemented by programming into computer-executive modules in program languages to achieve the mentioned functions.

      The video-audio playback system 324 synchronizes  
15   the decoded video and audio data according to the attached time stamp. The video-audio playback system 324 integrates the decoded real-time video data into game environment of the Internet game as texture mapping. The video-audio playback system 324 outputs  
20   the real-time audio data by a sound card with audio input or output. The real-time video-audio interaction between the Internet game clients is bi-directional, that is, the Internet game clients for real-time video-audio interaction are provided with  
25   both sender and recipient functions. All components and functions of both sender and recipient are provided in the sender Internet game client 300 and the recipient Internet game client 320.

      Figs. 4a, Fig. 4b are diagrams of the method of  
30   implementing real-time video-audio interaction by data

Client's ref.: 92022

File: 0660-9881-US/Final/Teresa/Steve

synchronization in an Internet game. An Internet transmission channel 50 is established for transmission. The camera 40 retrieves real-time video data and microphone 42 retrieves real-time audio data.

5       The data encoder 44, 46, compresses/encodes the real-time video data into video data frames, 440, 442, 444, 446, P frames. The data encoder 44, 46, also compresses/encodes the real-time audio data into audio data packets 460, 462, 464, L packets. The audio data  
10       packet takes priority over the video data frames. The video data frames and audio data packets are packaged into a transmission package 48. In other words, the audio data frame 460 is packaged first into the transmission package in one fixed time period and the  
15       video data frames 440, 442 are then packaged according to remaining bandwidth. If only N video data frames are packaged into the transmission package, then (P-N) video data frames are not. A time stamp is attached to the transmission package. The time stamp expresses  
20       the synchronous relationship between the video and audio data.

Through the Internet transmission channel 50, the sender Internet client transmits the transmission package 48 to the recipient Internet game client. The  
25       data decoders 52 and 54 decode the transmission package 48 into real-time video data 520 to 522 and real-time audio data 540. The Internet transmission may drop some video frames, only M video frames are received ( $M \leq N$ ). Obviously, the number of video data  
30       frames 440 to 442 is equal to or larger than the



Client's ref.: 92022

File: 0660-9881-US/Final/Teresa/Steve

number of video data frames 520 to 522. The video  
decompression method, such as IPB mode, may also cause  
video data frame drop such that only  $K$  ( $K \leq M$ ) video  
data frames are decompressed. Audio frames 540 are  
5 decompressed completely. Thus, the first package  
mechanism ensures smooth audio transmission and  
accurate synchronization of the video and audio data.

The video-audio playback systems 56 and 58,  
display the decoded video data by simultaneous support  
10 of real-time video and 3D animation, outputting real-  
time video data to game environments as texture  
mapping. The video-audio displayers 56 and 58, may  
synchronize data by adding the system time of the  
second internet game client to the time stamp and  
15 generating the display time of the second real-time  
video and audio data. Alternately, the video-audio  
displayers 56 and 58 may display synchronized data by  
comparing the time stamp to the number of frames  
dropped by the second real-time video data. The data  
20 synchronization can be accomplished before or after  
the data has been decoded by the decoders 52 and 54.  
The video-audio playback systems 56, 58, output audio  
data via a sound card with audio input or output 58,  
achieving real-time video-audio interaction.

25 The methods and systems provided by the present  
invention can be independent from an Internet game  
system by establishing an Internet transmission  
channel between Internet game clients. In addition,  
the invention applies the first audio data package  
30 mechanism and an attached time stamp to achieve smooth

Client's ref.: 92022

File: 0660-9881-US/Final/Teresa/Steve

audio transmission and accurate synchronization of the video and audio data, accomplishing real-time video-audio interaction by data synchronization in an Internet game. The invention enhances the reality of the Internet game without further burdening the Internet game server, resolving problems of the existing technology.

It will be appreciated from the foregoing description that the system and method described herein provide a dynamic and robust solution to real-time video-audio interaction problems. If, for example, an Internet game client changes data capture devices, the system and method of the present invention can be revised accordingly.

The methods and system of the present invention, or certain aspects or portions thereof, may take the form of program code (i.e., instructions) embodied in tangible media, such as floppy diskettes, CD-ROMS, hard drives, or any other machine-readable storage medium, wherein, when the program code is loaded into and executed by a machine, such as a computer, the machine becomes an apparatus for practicing the invention. The methods and apparatus of the present invention may also be embodied in the form of program code transmitted over some transmission medium, such as electrical wiring or cabling, through fiber optics, or via any other form of transmission, wherein, when the program code is received and loaded into and executed by a machine, such as a computer, the machine becomes an apparatus for practicing the invention.

Client's ref.: 92022

File: 0660-9881-US/Final/Teresa/Steve

When implemented on a general-purpose processor, the program code combines with the processor to provide a unique apparatus that operates analogously to specific logic circuits.

5        While the invention has been described by way of example and in terms of the preferred embodiments, it is to be understood that the invention is not limited to the disclosed embodiments. To the contrary, it is intended to cover various modifications and similar  
10 arrangements (as would be apparent to those skilled in the art). Therefore, the scope of the appended claims should be accorded the broadest interpretation so as to encompass all such modifications and similar arrangements.